L5: Entry 13 of 41 File: DWPI May 27, 2000

DERWENT-ACC-NO: 2000-524761
DERWENT-WEEK: 200048

TITLE: Optical fiber hydrogen loading system for fiber grating and long period grating fabrication, includes high pressure stainless steel tubing and valves, with pressure relief valves to prevent excess pressure build-up

INVENTOR: LONG, P

PATENT-ASSIGNEE:

ASSIGNEE	CODE
LONG P	LONGI

PRIORITY-DATA: 1998CA-2254016 (November 27, 1998)

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PATENT-FAMILY:

	PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
☐	CA 2254016 A1	May 27, 2000	E	006	G02B005/26

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
CA 2254016A1	November 27, 1998	1998CA-2254016	

INT-CL (IPC): G02B 5/26

ABSTRACTED-PUB-NO: CA 2254016A
BASIC-ABSTRACT:

NOVELTY - Small diameter stainless steel tube is used to load small amounts of hydrogen, using a diffuse chamber (D) to reduce the hydrogen concentration by mixing with nitrogen. A check valve (13) is used at end of exhaust pipe to allow exhaustion of only gases inside the loading system, and to avoid hydrogen mixing directly with air.

DETAILED DESCRIPTION - High-pressure valves (5-8) are used controlling high-pressure hydrogen and nitrogen gases, while pressure relief valves (14-17) prevent higher pressure in fiber loading chambers, in presence of high temperatures or abnormal situations. a close valve (11) is used to seal or exhaust H2 or N2 in the diffuse chamber, used for mixing the gases before they are lead outside of system. Special valve (10) is used to open and close H2 gas cylinder and regulator controls the gas pressure.

A METHOD is described for loading hydrogen used in fiber Bragg grating and long period grating fabrication.

USE - For safe fiber hydrogen loading for fabrication of fiber grating and long period grating.

ADVANTAGE - Method and apparatus have better safety measures taken to avoid causing any explosions. Enhances fiber photosensitivity and allows strong gratings to be fabricated in any germanosilicate fiber, including standard telecommunications fibers with low germanium concentrations.

DESCRIPTION OF DRAWING(S) - Drawing shows fiber hydrogen loading system.

Fiber loading valves 1-4

High-pressure valves 5-8

Hydrogen gas pressure regulator 10

Pressure sealing or exhaust valve 11

Check valve 13

High-pressure relief valves 14-17

CHOSEN-DRAWING: Dwg.1/1

TITLE-TERMS: OPTICAL HYDROGEN LOAD SYSTEM GRATING LONG PERIOD GRATING FABRICATE HIGH PRESSURE STAINLESS STEEL TUBE VALVE PRESSURE RELIEF VALVE PREVENT EXCESS PRESSURE BUILD UP

DERWENT-CLASS: P81 V07

EPI-CODES: V07-F02B; V07-G01; V07-H01;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N2000-387871

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(12) (19) (CA) **Demande-Application**

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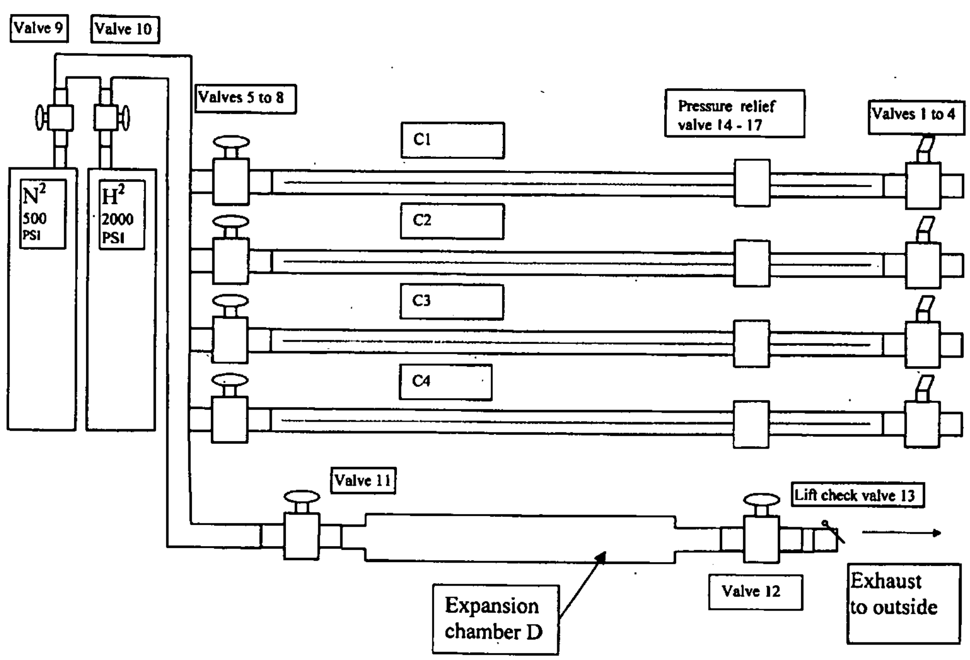
(54) **SYSTEME DE CHARGEMENT DE L'HYDROGENE PAR FIBRE OPTIQUE POUR LA FABRICATION DE FIBRE DE RESEAU DE BRAGG ET POUR LA FABRICATION EN RESEAU SUR UNE LONGUE PERIODE**

(54) **OPTICAL FIBER HYDROGEN LOADING SYSTEM FOR FIBER BRAGG GRATING FABRICATION AND FOR LONG PERIOD GRATING FABRICATION**



Patent name: Optical fiber hydrogen loading system for fiber Bragg grating fabrication and for long period grating fabrication

Background:

UV light can induce a permanent refractive index change in some kind optical fibers and optical wave-guides. The photosensitivity of the certain kind optical fiber waveguide can be used to make Bragg grating and long period gratings, which is a permanent, spatially periodic refractive index modulation along the length of the photosensitive core of the optical fiber or optic wave guide. Fiber Bragg gratings have many applications in optical fiber telecommunication, optical sensor and optical information process. [1]-[6]

Photosensitivity in germano-silicate fibers and the resultant index gratings in optical fibers were first demonstrated at the Communication Research Center, Ottawa, Ont., Canada, in 1978.[7],[8] They launched intense Argon-ion laser radiation into a germania-doped fiber and observed that after several minutes an increase in the reflected light intensity occurred which grew until almost all the light was reflected from the fiber. Meltz et al. from United Technologies Research Center (UTRC) reported that fiber Bragg gratings could be formed by exposing the core through the cladding glass to two interfering coherent UV beams called side writing technology. [9] Phase mask technique has some advantages over holographic writing approach.[10],[11] The phase mask is made from flat slab of silica glass which is transparent to ultraviolet light. The phase mask technique simplified the manufacture process for fiber Bragg gratings. In comparison with the holographic technique, the phase mask technique offers easier alignment of the fiber for photoimprinting apparatus and lower coherent requirements on the UV laser beam.

On the subject of fiber Bragg grating formation in optical fibers, photosensitivity is a measurement of index change that can be induced in the core of the fiber. There are two common approaches, which can increase the photosensitivity of a fiber core. One is called "Hydrogen loading"[12]. and the another one is "flame brushing"[13]. Hydrogen loading is a simple technique for achieving ultrahigh UV photosensitivity in GeO_2 doped optical fibers. This technique was first reported by Lemaire et al[12]. "Hydrogen loading" is carried out by diffusing H_2 molecules into fiber core at high pressure and low temperature. Subsequent exposure to UV irradiation then initiates chemical reduction of the glass, greatly increasing the index changes that can be obtained. Large permanent index changes in the fiber core as high as 10^{-2} have been achieved with this enhancing technique[14],[15].

There are several advantages of enhancing fiber photosensensitivity through the "hydrogen loading" technique. "hydrogen loading" allows strong gratings to be fabricated in any germanosilicate fiber, including standard telecommunication fibers that typically have low germanium concentrations and hence do not exhibit strong intrinsic photosensitivity. Enhanced photosensitization can be localized, index changes can be

induced over short lengths of fiber having the rest unaffected. Permanent changes occur only in the regions that are heated or UV irradiated, the unreacted H_2 in other sections of the fiber slowly diffuse out. Therefore, there is negligible absorption losses at the three principal optical communication windows.

Hydrogen loading technique has been used widely in fiber Bragg grating fabrication[16]-[18].

Because H_2 gas has a potential possibility of causing explosion if it is mixed with Oxygen under flame or sparks. It could be not sate in the circumstances that the H_2 is not properly treated. No one has studied the fiber hydrogen loading system or fiber hydrogen loading equipment in very details. Most of the fiber hydrogen loading systems is home made without properly and safe approaches.

Invention

In the present invention a new fiber hydrogen loading system with some safe approaches for fiber Bragg grating fabrication and long period grating fabrication is presented.

Hydrogen loading system:

A hydrogen loading system consisted of high-pressure fiber loading chambers, hydrogen leading system, Nitrogen purge system, and gas exhaust system is shown in figure 1. C1, C2, C3 and C4 are high-pressure stainless steel tubing used as fiber loading chambers, Valve 1 to Valve 4 are high-pressure valves for fiber loading and fiber unloading. Valve 5 to Valve 8 are also high-pressure valves for controlling high-pressure H_2 gas and high pressure N_2 gas. Valves 14 to valve 17 are pressure relief valves to prevent higher pressure in the fiber loading chambers when a higher pressure than normal occurs in the fiber loading chamber due to high temperature or abnormal situation. Valve 11 is used for sealing and exhausting high pressure H_2 or N_2 gases in the system to diffuse chamber D. Diffuse chamber D is used to mix H_2 and N_2 before they are leaded to outside. Valve 12 is used to purge gases inside diffuse chamber D to outside. Check valve 13 is used to prevent the outside gases (atmosphere) into the fiber loading system. Valve 9 is used to open, close N_2 gas cylinder, Valve 10 is used to open and close H_2 gas cylinder. Regular 1 is used to regulate and control N_2 gas pressure and Regular 2 is used to regulate and control H_2 gas pressure.

The fiber hydrogen loading system is working in the following sequences:

1. Loading fibers (or loading other wave-guide), by open valves 1 to valve 4. After finishing loading fibers, close valve 1 to valve 4.
2. Purge loading chambers and whole system, by close valve 11, and open valve5 to valve 8, open valve 9. Then close valve 9 and open valve 11 and valve 12. .
3. Repeat one more time of step 2.
4. Loading high pressure H_2 gas: close valve 11, close valve 9, open valve 5 to valve 8, then open valve 10. After loading chamber pressure is as same as the pressure of H_2 cylinder, close valve 10 and valve 5 to valve 8.
5. Keep loading chamber high pressure for several days (from three days to ten days depending on the requirements for fiber loading).

6. Clean leading channel: close valve 11, open valve 9 until certain pressure. Close valve 9 and open valve 11 and valve 12.
7. Diffuse H_2 gas: close valve 12, open valve 11, slowly open valve 5 and let the H_2 gas fill in the diffuse chamber D, then open valve 9 to regulate the N2 pressure to a certain value such as 500pi and let N2 mix with H2 in the diffuse chamber D.
8. Exhausting $H_2 + N_2$ mixing gases: slowly open valve 12, and let $H_2 + N_2$ gases leading to outside.
9. Repeat step 7 to step 8 for valve 6 to 8 to diffuse the H_2 in fiber loading chamber C2 to C4.
10. Purge loading chamber and whole system again three times, as same as step 2.
11. Isolate the fiber loading chamber by close valve 5 to valve 8.
12. Unload fibers: open valve 1 to valve 4 to unload fibers.
13. Close system: close valve 1 to valve 4.

In the invention N_2 gas is used to purge the fiber loading chamber and whole system, before loading fiber and after fiber loading is finished, to avoid the H_2 gas mixed directly with air for making the system operation more safely.

In the invention a check valve is used at the end of the exhaust pipe to allow only the gases inside the fiber loading system going to outside and to avoid the air from outside coming into the fiber loading system.

In the invention small stainless steel tube (such as 1/4 inch in diameter) is used as fiber loading chamber to keep small amount H_2 gas inside fiber loading chamber for safety reason. The length of the fiber loading chamber could be more than 1.5 meters so the long fiber gratings can be written with this kind H_2 loaded fibers and high yield of H_2 loaded fiber production can be obtained.

In the invention large size of valves, which are used to load and unload fibers, will be used to make the fiber loading and fiber unloading more easy and convenient especially in the situation of the small diameter fiber loading chamber.

In the invention, before the H_2 gas in the fiber loading chamber should be purged out, the H_2 gas in the fiber loading chamber should be mixed with N_2 gas in the diffuse chamber to reduce its concentration. Diluted H_2 gas mixed with N_2 gas together will be leaded to outside to make the fiber loading system operation more safe.

In the invention, pressure relief valves can be used in each fiber loading chamber to relieve a higher pressure than the normal one occurs in the fiber loading chamber due to high temperature and abnormal situation.

In the invention, the fiber loading chambers, made from stainless steel tubing, can be one to many numbers and all of them can share the leading gas pipe system.

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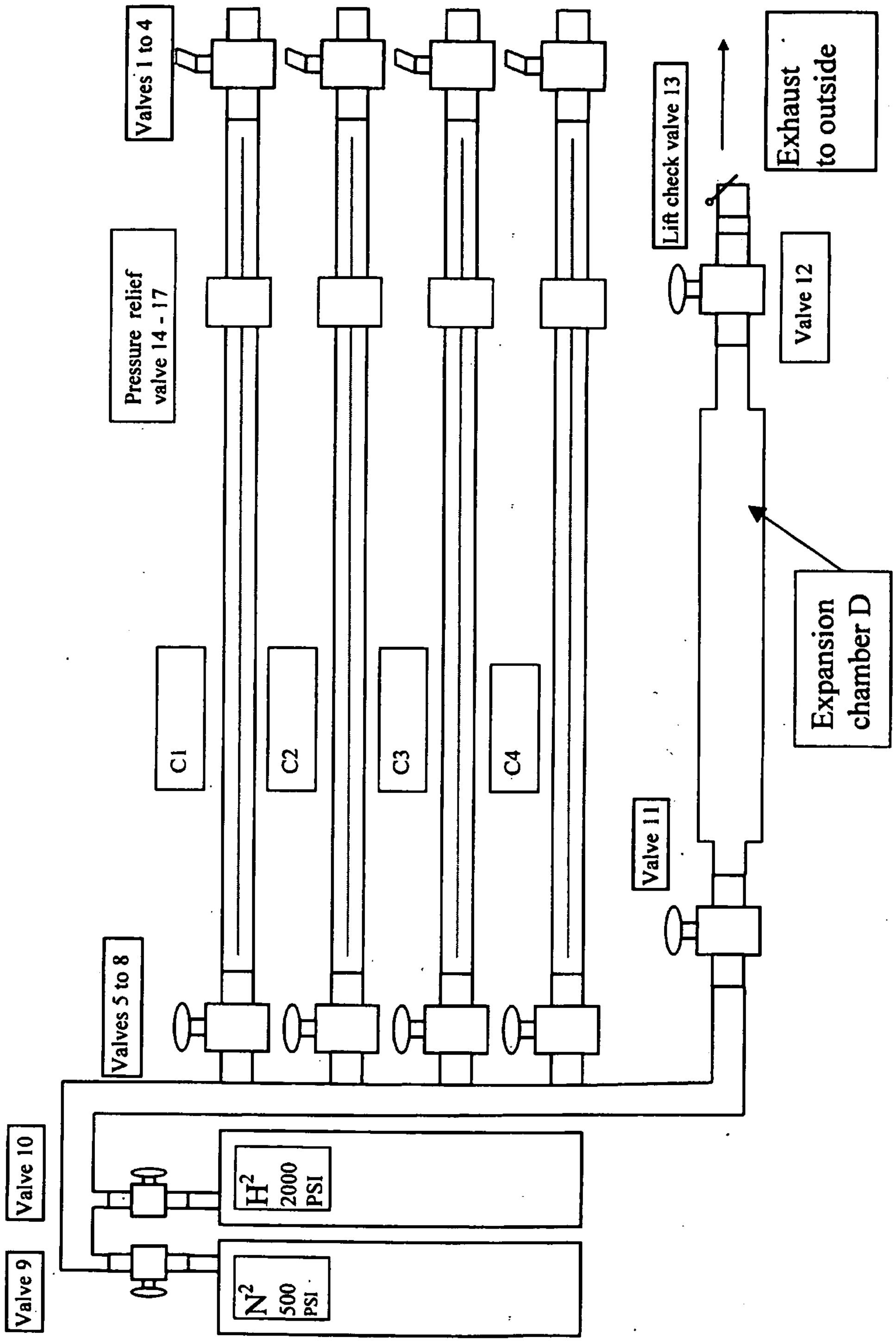
Valves 1 to 4
Pressure relief valve 14 - 17
Lift check valve 13
Exhaust to outside
Valve 12
Expansion chamber D
C1
C2
C3
C4
Valve 11
Valves 5 to 8
Valve 10
Valve 9
H^2 2000 PSI
N^2 500 PSI

figure 1.